

Investment Mode 5: Societal Implications and Workforce Preparation

Societal Aspects

When new technologies with high impact are developed, societal issues often arise. These issues require specific measures to take best advantage of opportunities while reducing the potential risks associated with technology development and subsequent commercialization. The NNI provides funding for research that addresses the ethical, social, legal, economic, and workforce implications of nanoscience and nanotechnology. For example, following the establishment of the NNI in FY2001, NSF has introduced a theme on, “Societal and Educational Implications of Scientific and Technological Advances on the Nanoscale” in its Nanoscale Science and Engineering program solicitation. Studies under this program include economic implications of innovation; knowledge barriers to adoption of nanotechnology in commerce; implications for health and the environment; educational and workforce needs; ethical issues; and implications of new fields arising at the intersection of traditional areas of science and engineering. Some specific examples include the following:

- The University of Virginia received a five-year NSF award for 2001-2006 to investigate “Ethics and Belief Inside the Development of Nanotechnology.”
- The University of South Carolina received an award in 2002 to study “Philosophical and Societal Dimensions of Nanoscale Research.” This award helped to create a center on societal implications of nanotechnology at that university.
- Another award supports the creation and maintenance of a nanotechnology commercialization database.

Education and Training

Science, engineering, and technology education play three critical societal roles in (1) producing the next

generation of researchers and innovators, (2) providing the workforce of the future with the technological skills they will need to succeed, and (3) educating a citizenry capable of making well-informed decisions in an increasingly technologically driven society. The NNI plays a special role in each.

With respect to training future scientists and engineers, a major impact of NNI-supported research is the hands-on training of undergraduates, graduate students, and postdoctoral researchers via funding of nanoscience and nanotechnology research at universities. NNI programs also provide direct funding for student fellowships and traineeships. Because nanotechnology research often cuts across traditionally distinct disciplines, including physics, chemistry, biology, materials, mathematics, and engineering, new teaching paradigms that emphasize a multidisciplinary approach to research will be particularly relevant.

Industry must have an adequate supply of skilled technical workers in order to meet the increasing workforce demands that are expected to accompany progress in nanotechnology. A key objective of the NNI is to develop new approaches to education and training that will lead to a new generation of skilled workers with the multidisciplinary perspective and knowledge necessary for rapid progress in nanotechnology. Such programs are aimed at community colleges and other institutions and programs that emphasize job-related skills, as well as at four-year colleges and universities.

Clearly, education and training takes place well before the college level in the primary and secondary schools. Therefore, improvement in K-12 science and mathematics education is critical not just to nanotechnology but to all scientific and engineering disciplines. Towards this end, the NSF Nanoscale Science and Engineering Centers have funds specifically aimed at addressing K-12



education. In addition, the National Nanotechnology Coordination Office (NNCO) has prepared a paper entitled, “Extending Outreach Success for the National Nanoscale

Science and Engineering Centers—A Handbook for Universities,” which provides information on how universities can engage K-12 educators and students.

National Nanotechnology Coordination Office Activities

Outreach is an important component of the NNI. One mechanism by which outreach is accomplished is through the National Nanotechnology Coordination Office, which serves as the point of contact on Federal nanotechnology activities for government organizations, academia, industry, professional societies, foreign organizations, and others. Examples of the mechanisms by which the NNCO communicates with interested parties are the publication of reports on workshops organized by the NSET and ongoing development and maintenance of the NNI website (www.nano.gov).

The NNCO also facilitates outreach to a broad cross-section of industry, another NNI objective. For example, the NNCO is working with members of NSET and DOC’s Technology Administration to organize a series of regional workshops to increase industry awareness of pending nanotechnology developments and address scientific and technical deficiencies that are limiting industrial commercialization of nanotechnology. The first workshop (western region) was held on Sept 10, 2001, at UCLA. The second (southern region) was held in Houston, Texas, on May 23, 2002. Additional meetings are to be held in the mid-western and eastern regions.

Outreach to regional, state, and local organizations that are coordinating nanotechnology-based efforts is also an integral part of NNCO’s mission. The list of states that have organized nanotechnology programs is a lengthy one and continues to grow. Other state programs that are not specifically directed at nanotechnology are also providing support to ventures in this area. For

instance, Nanoscale Materials, Inc., was the first tenant in Kansas State University’s K-State Research Park. In addition, the NSF’s Experimental Program to Stimulate Competitive Research (EPSCoR), which supports development of research infrastructure in less research-intensive states, has provided funding to Oklahoma for NanoNet. This program coordinates a statewide network of scientists and engineers, including students at state colleges and universities, involved in developing three critical nanoscale components: epitaxial nanostructures, colloidal particles, and integrated circuit connectors.

Several private initiatives also are accelerating the introduction of nanotechnology into the market. For instance, the NanoBusiness Alliance is actively fostering nanoscience and nanotechnology by compiling three nanotechnology directories for the venture capital, industry, and nanotechnology service and support communities. The NNCO contributes to these efforts as an information resource.

Through the NNCO, as well as the participating agencies, the NNI maintains close ties with professional societies as a valuable means of disseminating information on current activities, promoting education for nanoscale science and technology, and as a source for insight on opportunities for future research. In addition, as the worldwide investment in nanotechnology grows, it is vital that the NNI reach out to programs, institutions, and researchers overseas to foster collaboration and to allow U.S. nanotechnologists to learn from activities taking place abroad.